THE PREVENTION OF INTESTINAL OBSTRUCTION FOLLOWING OPERATION FOR APPENDICITIS.*

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It may safely be said, I think, that in this country each succeeding year has brought with it an increasing number of cases of appendicitis which have been diagnosed as such at an earlier period in the disease. With this advance in diagnosis has also come an increase in the number of cases that have been operated upon. In fact there is hardly at present a community of fair size that does not count among its numbers one or more surgeons who have operated a number of times for appendicitis. After having diagnosed the case properly, removed the diseased appendix, closed the wound with or without drainage as the case may be, and returned the patient to bed, there ensues for all surgeons a more or less anxious period lasting from several days to several weeks. Of the post-operative complications liable to occur during this period, intestinal obstruction and sepsis form a serious percentage.

A number of cases of postoperative obstruction in which the writer has been called in to operate within the last few years have led him to consider more closely the causes of this complication in these individual cases and the methods by which it may usually be avoided.

This postoperative complication is not an infrequent one —it varies from a fraction of one per cent. to ten per cent. or more according to the operator's skill and experience.

The obstruction is usually either (*a*) mechanical or (*b*) septic, or a combination of both. There is also a so-called spasmodic form about which authorities differ greatly. The occurrence of this form is doubtless quite rare. It is not here considered, nor is that resulting from mesenteric thrombosis.

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a. MECHANICAL OBSTRUCTION.

As a postoperative complication this occurs less often than we would expect in the cases where the conditions would seem at first thought to be most favorable for it—namely in those of acute generalized suppurative peritonitis with the production of many adhesion bands. The reason that many cases of this kind are free from this complication is doubtless that here many of the loops are united to each other by the exudate while they are in a normal position and are thus held together for some time—the later process of absorption occurring pretty evenly over the various surfaces if the focus of inflammation has been removed. The comparative rarity of mechanical obstruction in cases of pyosalpinx, and especially tubercular peritonitis where the greatest amount of adhesive material is often formed, would tend to corroborate this view.

The type of case most liable to this postoperative complication seems to be that in which most of the peritoneal cavity is free from adhesions, permitting unrestricted intestinal motion, but where a few firm adhesions are formed after operation between the caput coli and an adjacent loop of small intestine. Gibson[1] in 1000 cases of postoperative intestinal obstruction found the small intestine involved in 95 per cent. McWilliams[2] collected 86 cases of postoperative obstruction —all in the small intestine—69 following appendicular abscess.

The following cases are fairly typical of this condition:

Case I.—E. W., 25 years of age, male. Had been operated on by his physician on Long Island for chronic appendicitis on June 15, 1907. Considerable inflammation had been found at the tip of the appendix which had to be dug out from its adhesions over the pelvic brim. The appendix had been removed and a cigarette drain placed to the stump area. The patient had done nicely for a few days following the operation and the drain had been withdrawn and partially replaced. He had then begun to vomit occasionally, the intervals between the attacks becoming of shorter and shorter duration. The bowels which had moved well at first had become constipated and finally the enemata had returned clear, only a very slight amount of gas being expelled. The pulse rate had remained 80 to 100 and the temperature normal. Nine days after the operation the vomiting had become fecal. I saw him late this same day for the first time; he looked distinctly anxious, the pulse was about 100, with appreciable tension; the temperature was normal. The abdomen was moderately distended and a little tender; no mass could be felt. On listening to the abdomen with a stethoscope for several minutes only two very faint gurgles were heard. No peristaltic waves could be seen; there was no dulness in the flanks. On rectal examination no mass could be felt and the examination was not painful. A diagnosis was made of mechanical intestinal obstruction. Immediate operation was advised and accepted. Under gas and ether anæsthesia an incision was made (Dr. Hawkes) to the umbilical side of his previous incision, through the outer fibres of the right rectus muscle. The peritoneum was not adherent here. There was no free fluid in the general peritoneal cavity. A twisted loop of small intestine was found adherent to the caput coli at the site of the drain, on the umbilical side of the caput. The bowel above the obstruction was dilated and thickened, below it was contracted and entirely collapsed. There were no adhesions to be felt in the pelvis or elsewhere in the abdomen. The twisted loop was separated from its adhesion area to the caput coli. Its adhesion surface was oval, of about one to one and a half inches in diameter. In a few minutes the contents of the bowel above were slipping past the area of previous obstruction and the diameter of the bowel below was distinctly increased. After the separation from the caput coli the affected loop was seen to lie directly under the recent abdominal incision, where it was allowed to remain. The cigarette drain was removed from the old wound and a small piece of rubber tissue was introduced into the outer part only of the sinus tract. The fresh wound was closed in layers, leaving in only a small piece of gauze as a drain down to the peritoneum. The patient made a good recovery. His vomiting stopped and his bowels moved of their own accord within twelve hours and after that regularly. His convalescence was interrupted ten days following the operation by a small collection of pus which formed in the bottom of the pelvis (probably from a small amount of blood that had trickled down into the pelvis at the time of the second operation. This collection bulged toward the rectum, his physician reported, and was there opened by the finger. It went on promptly to complete healing. The patient was heard from six months later. He was then in perfect health.

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[1] Gibson, Anns. Surg. Vol. 32. p. 425.

[2] McWilliams, Wash. Med. Ass. 1905.

CASE II.—N. H., 20 years of age, male. Had been operated on by his physician in New York City, July 22, 1907, for gangrenous appendicitis. The abdominal incision had been made at the edge of the right rectus muscle. The appendix had been found behind the caput coli imbedded in adhesions and its removal had been a difficult one. After its removal drainage had been instituted through the abdominal incision. The patient had made a good recovery and his bowels had moved well for several days following the operation. Then he had begun to have abdominal pain with constipation and had vomited occasionally. On the ninth day following the operation, he had begun to have fecal vomiting, the rectal enemata had returned clear and no gas had been passed by rectum. The writer saw him about twelve hours after his fecal vomiting had begun. The clinical picture was almost precisely that described in Case I. Diagnosis was made of intestinal obstruction from a loop of small intestine adherent to the caput coli at the site of drainage and immediate operation advised; consent to this was not obtained for about six hours. Under gas and ether an incision was then made (Dr. Hawkes) to the umbilical side of his previous incision through the fibres of the right rectus muscle. The peritoneum was not adherent here. A condition almost identical with the one described in Case I was found—a loop of small intestine twisted and adherent to the caput coli at the site of drainage to the umbilical side of the caput by an irregular shaped surface—distention and thickening of the loop above the obstruction, collapse below it. After separating the loop it lay directly under the fresh incision, where it was left after its contents were felt and heard to slip downwards, past the area of previous obstruction. The abdominal wall was sewed up in layers, a small gauze drain being inserted through the muscles only. The patient made an excellent recovery. The vomiting stopped almost immediately. The bowels were moved by enema on the third day and after that regularly. His convalescence was uneventful and he left the hospital· in excellent condition.

In both of these cases the obstruction in the loop of small intestine was not at the site of the appendix stump, but corresponded to the area on the umbilical side of the caput where gauze drainage had been instituted. The prevention of the firm adhesion material or band formation in this locality may best be affected by:

a. Making the operative entrance into the peritoneal cavity well out towards the anterior superior spine of the ilium directly over the caput coli.

b. Instituting right iliac fossa drainage when necessary to the outer side of the caput coli.

c. Instituting pelvic drainage likewise when necessary to the outer side of all intestinal coils, by means of a suitable drain, the drainage tract having for its outer wall the lateral parietal peritoneum of pelvis and of right iliac fossa.

d. Protecting the coils of small intestine by means of an omental barrier.

a. The Abdominal Incision.—By making the abdominal incision an oblique one from one to one and a half inches within the anterior superior spine of ilium (see Fig. 1) and by splitting the fibres of the external oblique in the same line as the skin incision, a retraction of the outer part of the external oblique aponeurosis will expose the internal oblique muscle nicely; the fibres of the latter are then separated and the transversalis fascia and peritoneum divided halfway between the outer edge of the rectus muscle and the anterior superior spine of the ilium. This will in most cases give an opening into the peritoneal cavity directly over the caput coli. If one attempts to open quite near the anterior superior spine, the result may well be that the dissection will lead down ineffectually into the retroperitoneal tissue, leaving a pocket there for postoperative trouble, or the bowel may be opened without getting into the general peritoneal cavity. If the opening be made too far out at the edge of the rectus muscle a coil of small intestine may present itself instead of the caput. This is an objection.

b. The Proper Placing of the Drain to the Stump Area, in the Right Iliac Fossa.—This I consider to be of great post-operative importance in the cases where drainage is needed. Through such an opening as is recommended above a drain when indicated can be so placed that the secretion will be led up along the outer side of the caput coli and then into the outer dressings (Fig. 1). A drain placed to the inner (*i.e.*, umbilical) side of the caput coli in apposition with coils of small intestine (especially if it be a gauze drain) will of course cause marked adhesion formation and may well give rise to the complication existing in the two cases previously mentioned.

In the gangrenous cases where in addition to the gangrene of the appendix there are spots of juxtaposition gangrene on the caput coli or small intestine, a piece of gauze either as a separate drain or as a part of the distal end of the stump area drain should of course be placed against such spots. Such a drain should, however, be surrounded by rubber tissue throughout the rest of its course in the wound and it should also be led to the surface to the outer side of the caput. It is hard to lay down exact rules as to the amount of drainage necessary in every drainage case. Clinically the principle here enunciated seems sound; one thing also seems certain; the lower abdominal and pelvic peritoneum in the male cannot take care of infection as does this organ in the female and requires as a rule provision for more ample drainage. Rubber tissue and gauze cigarette drains without gauze projection from the lower end unless there be a gangrenous spot to cover, represent to my mind the best form of drain for the average case that requires drainage.

c. The Institution of Pelvic Drainage.—When the pelvis is to be drained the pelvic drain should preferably be of rubber tissue and gauze, the rubber tissue being wrapped around the gauze loosely, leaving likewise no gauze projection from its lower end. In this way the greatest amount of drainage with the minimum amount of adhesion formation is secured. This drain should always be introduced (under the guidance of the fingers of the other hand) so that it lies directly against the outer pelvic wall from the abdominal incision down to the very bottom of the pelvis. The failure to introduce such a drain to the very bottom of the pelvis may result in the formation of a pool in Douglas's or in the rectovesical pouch, which may in time give rise to further peritonitis causing mesenteric thrombosis or intestinal obstruction. This pelvic drain needs as a rule to remain in the pelvis not more than thirty-six hours in a comparatively recent case of spreading peritonitis with serum only or slightly turbid seropus in the pelvis. In the older cases, however, associated with heavy and scattered lymph plaques in the pelvis and localized pus collections there, a more prolonged pelvic drainage is indicated. In these latter cases a too early discontinuance of the pelvic drainage may be followed by pelvic re-accumulation of pus with subsequent intestinal obstruction. Cases with a perforated gangrenous tip located deep in the pelvis should be similarly drained. Localized collections of pus anywhere in the abdomen are inviting areas for intestinal obstruction. When it is possible it is advisable to open these so that the gravity drainage from them will be along the tract of the pelvic drain. Should this not be feasible they should be drained through that portion of the anterior or lateral abdominal wall which is nearest to them.

Retrocæcal or retrocolic abscesses may best be drained usually through an additional counter opening in the flank (see Fig. 1). Here on account of the position of the abscess plain gauze may be used as a drain or preferably a cigarette drain of gauze enveloped in rubber tissue but with an inch or so of gauze projecting from its lower end. The gauze portion soon becomes adherent to the retrocæcal or retrocolic cellular tissue and thus prevents this drain from being extruded by the action of the lateral abdominal muscles. About the fourth or fifth day such a drain may be removed with very slight discomfort to the patient. The writer does not feel that the introduction of sterile salt solution into the peritoneal cavity in cases of gangrenous appendicitis is advisable. Many of them have the gangrenous part of the lesion confined to the right iliac fossa or in a limited way to a small portion of the upper part of the pelvis. Here the salt solution may scatter a secondary previously localized form of infection to other parts of the lower abdominal and pelvic cavities. When a drain is used it should never be nipped at its exit from the peritoneal cavity by too tight suturing. If so it acts as a stopper, not as a drain. Of course the best way to prevent firm adhesion is to operate early if possible in cases of appendicitis at a time when drainage will probably not be necessary. When the condition

FIG. 1.

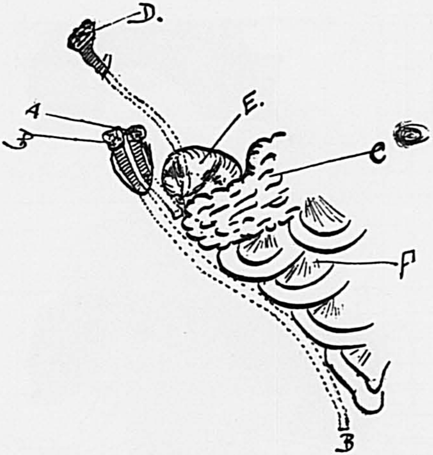
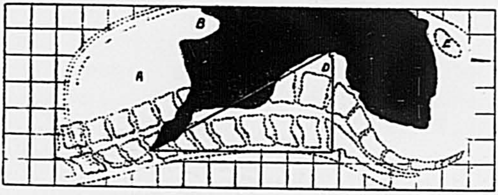


Diagram illustrating the proper placing of the various drains and of the protecting omentum. *A*. The drain to stump area, leading down on the outer side of the caput coli; rubber tissue and gauze cigarette drain without any projection of selvage gauze from the lower end. *B*. The pelvic drain, leading down to bottom of pelvis on the outer side of all intestinal coils; rubber tissue and gauze cigarette drain, no projection of selvage gauze from the lower end. *C*. Protective omentum placed between appendix stump site and small intestines. *D*. Drain leading to site of retrocæcal or retrocolic abscess by secondary "stab" opening in flank; rubber tissue and gauze cigarette drain with ½–1 in. selvage gauze projection from inner end. *E*. Caput coli. *F*. Loops of small intestine.

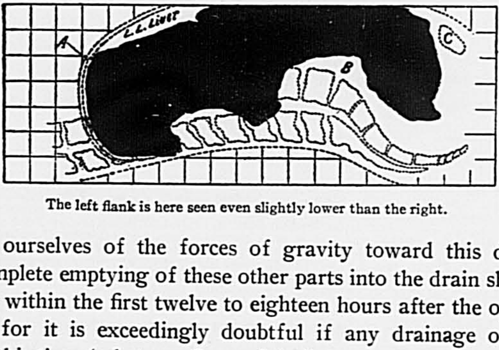
demands drainage, however, the lightest form of adhesion production with the greatest amount of actual drainage should be aimed at. And here while on the subject of drainage it is pertinent to recall that if we wish to drain other parts of the abdominal cavity which are not in direct contact with the capillary drain, yet not shut off from it by adhesions, we must avail ourselves of the forces of gravity toward this drain. A complete emptying of these other parts into the drain should occur within the first twelve to eighteen hours after the operation, for it is exceedingly doubtful if any drainage occurs after this time (whatever form of drain be used) from portions not in contact with the drain. In the writer's experience the least irritating of all drains, the loosely rolled cigarette drain with rubber tissue covering without any projection whatever of gauze from its lower end, will drain adjacent regions perfectly (if adhesions have not formed in them before operation and if the fluid to be drained is not too thick) for twelve to eighteen hours, no more.

Fig. 2.



The right flank is here seen one inch deeper than the pelvis.

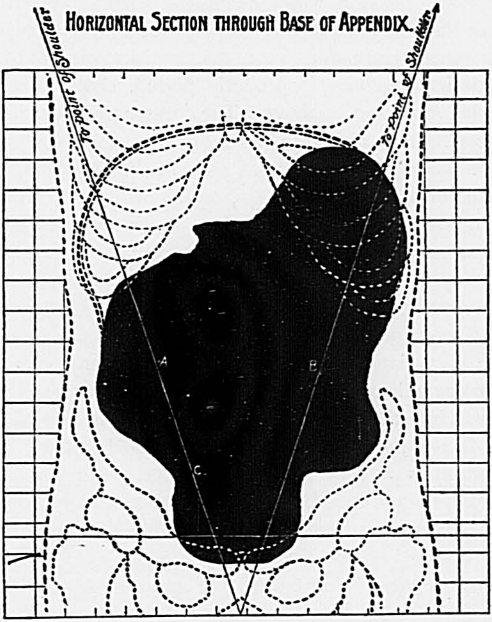
Fig. 2 a.



The left flank is here seen even slightly lower than the right.

Fortunately this is often sufficient if the drain is of adequate size and the patient kept in the proper position in bed. The accompanying diagrams reproduced in part from Dr. R. C. Coffey's [3] article and showing the various fossæ to be drained explain at a glance the proper position in which the patient is to be placed for drainage in various classes of cases. For instance, in cases of retrocæcal abscess alone without free serum or free seropus in the abdominal or pelvic cavities the dorsal position with lumbar opening in the right loin is indicated. In a case of retrocæcal abscess with free serum or free

Fig. 2 *b*.



Considering Fig. 2 and Fig. 2 *b* together it will be seen that if the patient is first turned over on the right side while in the horizontal position, and then put up in "Fowler position," perfect gravity drainage of all fossæ may be secured.

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[3] Coffey, J. Am. Med. Ass., March 16, 1907.

seropus in the abdominal and pelvic cavities pelvic drainage and lumbar counter-opening with the Fowler position for about twenty-four hours is best. Clinically the pelvis will by that time have drained off the serum or seropus that has gravitated from above and the patient may then be placed in the horizontal position, when the lumbar drain will continue its work; or the patient may from the start be simply turned over entirely on the right side, for in this position the lumbar and pelvic drains together, if properly placed, should drain the whole abdominal cavity above. The former method, however, the writer believes to be the better one.

The placing of gauze or of pads to the umbilical side of the caput coli in clean cases as a routine procedure during the operation seems to the writer to be a faulty technic; they are apt to cause adhesions, they often interfere with rapid and satisfactory manipulations, thereby causing delay, and they may very well produce displacement in the way of twisting of the small intestinal loops. When removed they probably often pull the small intestinal loops into abnormal positions where they become adherent. In the pus cases or in cases associated with great intestinal distention their use may be necessary; as few as is possible, however, should be used. Their proper introduction is a very important matter. They should be introduced only after the exact site of the caput coli and appendix region has been noted. Care should be used that no coils be caught between them.

A secondary infection of the peritoneum during the operation from the hands of operator, assistants, or nurses must be avoided. Sterile rubber gloves should be worn by all. The operator's gloves should be of the lightest weight to secure the greatest delicacy of touch, and the best appreciation of the exact pathological changes that have occurred in the operative field.

The delivery of the caput coli outside the abdominal wound as a *routine* measure in hunting for the appendix is a procedure which is both unnecessary and injudicious. In many cases the location of the appendix can be made out after the peritoneum has been opened, by introducing one finger to the lower part of the caput coli and exploring in this region. When thus located if there are softish adhesions they may be carefully separated by the finger until the appendix seems free and a small sponge or bit of gauze on a holder introduced below the appendix will then often deliver the appendix nicely into the wound, without a single coil of small or large intestine displaced out of the wound. Even in pus cases the same steps may be carried out after the sponging out of the abscess cavity. Of more importance still than the retaining of the caput in the peritoneal cavity is the retaining of all small intestine coils; these are very apt to become displaced with the caput and to be replaced in a wrong position. All peritoneal surfaces of the bowel that are handled and exposed to the air for any length of time are traumatized thereby and the musculature more or less temporarily paralyzed. It is not at all unusual to see appendectomy cases where no portion of the intestine except the appendix has been brought out of the wound during the operation, and where no pads have been introduced, recover their intestinal tone within twelve to fourteen hours as evidenced by the passage of quantities of gas by rectum within sixteen to eighteen hours after the operation.

In women the pelvic drainage may be brought from Douglas's cul de sac through the vagina. There is a chance here, however, that a pool may form in the undrained fossa between the anterior surface of the uterus and the bladder. For this reason I prefer the pelvic drain which issues by the abdominal wound, and by having the patient, who is in Fowler's position, turned well over occasionally on the right side this fossa will drain into the pelvis nicely. In the writer's experience young children who toss about a good deal after operation thereby secure for themselves unwittingly excellent drainage.

d. Omental Protection of the Small Intestines.—After the removal of the appendix (and the placing of the drain or drains if required) whenever possible a piece of the great omentum should be brought down from above and placed as a barrier between the coils of small intestine and the stump site (see Fig. 1).

This latter procedure is not practised by many surgeons. The writer's statistics in postoperative appendix work lead him to regard this as a very valuable prophylactic procedure, which he has made use of as a routine measure for a number of years. It simulates in a way nature's method of preventing the further spread of peritoneal infection and adhesion formation to intestinal loops. In most cases this omental protection can be effected. Where no omentum can be seen the appendix stump can often be placed under the fold of a divided mesoappendix, or under the ileocæcal fold, or a fatty tab from the caput can be brought over it.

It would seem that mechanical intestinal obstruction is of more common occurrence in cases of appendicitis which have not been operated on, than in those where operation has been properly done and the after-care of the wound properly carried out. In the former type of case the adhesions being often older are apt to be more firm and unyielding. They do not tend so much to be absorbed because the cause of the adhesion formation still persists. Old adhesion strings found in the abdominal cavity at the time of operation had usually best be divided close to their origin.

b. SEPTIC OBSTRUCTION.

In most of the cases of septic obstruction following an operation for appendicitis, this condition is but the result of the further progress of the sepsis that existed before the operation. The means to be taken therefore to prevent further spread of the septic peritonitis are the ones that should be used to ward off the secondary obstruction. In brief these are:

a. Removal of the appendix (if it can be done quickly).

b. Free drainage of the inflammatory area surrounding the appendix site, in the way mentioned.

c. Free drainage of pelvis (if the infection has spread to it) according to the methods previously outlined.

d. All operative measures to be instituted with the greatest rapidity consistent with safety.

e. Assumption of Fowler's position directly after the operation (at an angle about 80°).

f. Rectal instillation of hot normal saline solution, *p. o.*

g. Absolute intestinal rest by withholding all food and medication by mouth for 36–48 hours.

h. Stimulation as indicated.

i. Careful post-operative wound treatment.

j. If the above are not sufficient then "ileostomy."

In a case of spreading septic peritonitis following the operation, as soon as the diagnosis is certain, if the free drainage above mentioned is insufficient, the surgeon should not await the advent of fecal vomiting but should open the loop of small intestine which is nearest to the caput coli in the wound; a rubber drainage tube of suitable calibre should be introduced into the proximal loop and retained therein by a purse-string suture. Should this loop be not adherent at the time to the surrounding surfaces a small piece of gauze should be placed around the suture line to produce protective adhesions. The resulting fistula may be closed later after the bowel has regained its tone. The following case demonstrates the value of this method.

T. B., 50 years of age, dentist, had a mild attack of appendicitis in 1906 from which he recovered nicely; he was laid up at that time for only a day. His physican advised him to have his appendix removed in the interval, but this advice was not followed. On May 2, 1907, he was seized with vomiting and abdominal pain. His physician saw him soon after the onset and found temperature and pulse rate normal, very slight abdominal tenderness and scarcely appreciable right rectus rigidity; his bowels moved well by enema. Within twelve hours, however, his pulse rate had advanced to 96, his temperature to 101° F., and he presented distinct rigidity over the right rectus and lateral abdominal muscles with exquisite tenderness over the appendix site; shortly afterwards he had a chill. Rectal examination was negative. He looked badly. The writer insisted on immediate operation and found a gangrenous appendicitis with a septic peritonitis confined to the right iliac fossa. The intestinal loops there seen were covered with lymph flakes, and the right iliac fossa contained a turbid yellowish serum. The appendix was rapidly removed and a rubber tissue and gauze cigarette drain of fair size placed to the stump area. During the first thirty-six hours after the operation the patient did not do well; vomiting occurred at intervals, at first mucous, then fecaloid, but not containing any fecal material; the abdomen became quite distended. No gas was passed by rectum. His septic peritonitis was evidently progressing and it was decided to institute freer drainage. The wound was opened, no mechanical obstruction was found, but a considerable amount of brownish-gray fluid with a foul odor around the bowel loops. This was sponged out and three cigarette drains were inserted; one above towards the liver, one to the stump area on the outer side of the caput coli, one into the pelvis on the right side along its outer wall. The patient was placed in Fowler's position. The vomiting, abdominal distention and absolute constipation, poor pulse, and general prostration persisted in spite of this free drainage. Very rarely a weak gurgle could be heard with a stethoscope over the abdomen. There was still evidently a progressing paresis of the gut, so it was decided to open the nearest loop of the small intestine. This was done about sixty-six hours after his first operation, a rubber drainage tube being sutured into the proximal loop and gauze applied sparingly around the suture line for protective adhesion. This was followed by the expulsion of much gas through the tube and a little later of a large amount of foul smelling greenish material containing particles of undigested food which he had eaten more than four days before. Similar material was obtained after the operation by gastric lavage. Following this ileostomy the vomiting stopped almost immediately and in twelve hours the whole clinical picture had changed; the abdominal distention became less, the patient looked much better, the pulse was greatly improved. Within twenty-four hours the bowels moved with enema by the rectum with the passage of much gas; he then went on slowly to recovery. Later his ileostomy wound was closed.

Postoperative Treatment of the Wound.—Where multiple or deep drainage has been instituted the proper replacement of these drains at needed intervals is a matter of great importance to the patient. It is the writer's practice on this account to give an anæsthetic as a rule for the first dressing in these cases, so that the proper replacement of the drains to the very bottom of the tract may not be interfered with by the reflex muscular contraction of the abdominal muscles, which otherwise often force the adjacent intestinal walls into the drainage tract and also narrow its mouth. I believe that where possible the operator himself should do the first dressing. An assistant will often fail to carry in his mind the exact depth and direction of the various drainage tracts and a previously drained pocket may thus be left undrained. The value of a voluminous *damp* gauze dressing into which the ends of the drains are fluffed is beyond question and it is the writer's practice to change this every 8 hours for the first 2 days, for it promotes free drainage in a marked way.

The giving of special drugs to produce marked intestinal motion or catharsis directly or within 2–3 days after operation has always seemed to the writer an inadvisable procedure. Nature splints the abdomen when it is endeavoring to rid itself of septic material that is present, as shown by the presence of muscular rigidity. We should take our cue from this and keep the coils quiet for 4–5 days usually, emptying the lower bowel by enema as required in the meanwhile.